AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. I. No. 3. BOSTON, JANUARY, 1902. Ten Cents a Copy

STUDIES IN ELECTRICITY.

Donald M. Bliss.

III. Methods of Connection.

Four methods of connecting electrical devices cover most of the field in engineering practice. Figs. 5 and 6 show two methods of connection which will be used most frequently by the experimenter. The Fig. 5, known as a series connection, shows the zinc or negative pole of one cell connected to the positive or carbon pole of its neighbor. The cells are all connected up in this manner as shown, leaving an unconnected positive pole at one end of the series and a negative pole at the other. This method of connection has the effect of adding the pressure of the cells together, so that the total pressure of the series is that of one cell multiplied by the number of cells so connected. For instance, if the pressure of the single cell is $2\frac{1}{4}$ volts, the pressure of the six cells connected in a series will be $13\frac{1}{2}$ volts. While the pressure or voltage is thus increased, it should be borne in mind that the total available current in amperes is only that of a single cell.

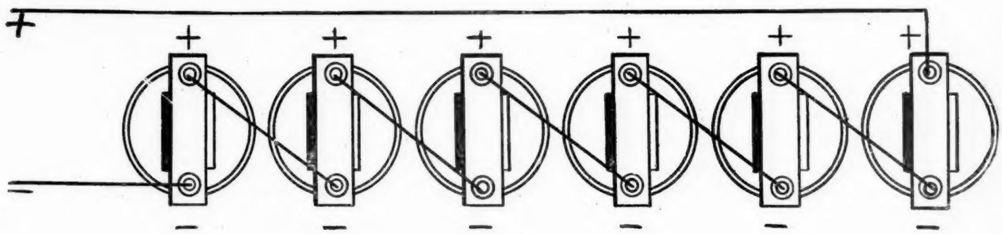


Fig. 5.

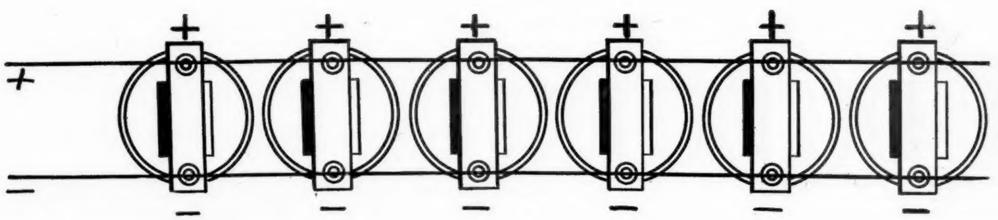


Fig. 6.

The amount of current that can be obtained in such a battery depends on the size of the negative and positive elements, and on the electrical resistance of the solution used in the battery. If it is desired to obtain from these cells the greatest amount of current, regardless of voltage, they must be connected in the manner shown in Fig. 6, known as the multiple, or parallel, grouping. In

this instance it will be noted that all the positive poles are connected together by an independent wire, and all the negative poles by another wire. The difference of pressure or voltage from one of the connected wires to the other is evidently only that of a single cell, say 2¼ volts. As all the positive plates are connected together to one wire, and all the negative plates to the other, the battery then becomes the same in effect as a single large cell, having positive and negative elements,

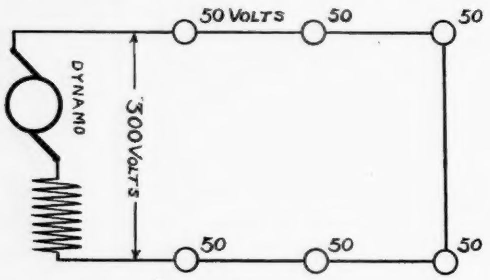


FIG. 7.

or plates, six times the size of a single cell. The available current is therefore six times as great, and the voltage of pressure one-sixth that of the series connection shown in Fig. 5.

While we are on the subject of connections, it will be well to illustrate the matter still further by reference to the most frequently used methods of connections in electric-lighting circuits. Fig. 7 shows the usual form of connection in series arc systems generally used for street lighting. The

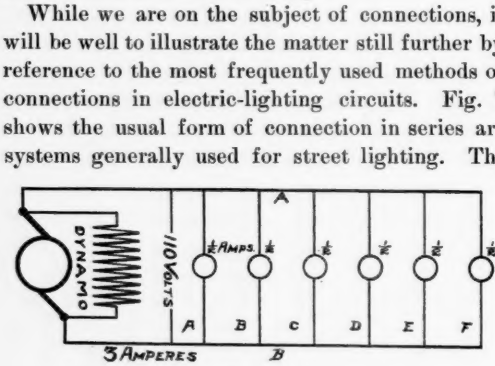


FIG. 8.

circles represent arc lamps in which the connections join one lamp in a series with another, so that the whole group of six lamps are in series connection with each other. If one lamp requires a voltage or pressure of about 50 volts, the six will require a total pressure of 300 volts, to operate them properly. As many as fifty lamps are sometimes connected in a series in this manner, and it will be seen that a total pressure of 2,000 to 3,000 volts may be necessary to operate a large number of arc lamps; and as the current becomes dangerous at about 500 volts, it can readily be seen why fatal accidents are occasionally met with on street-lighting circuits.

Fig. 8 shows the parallel, or multiple, connection generally used for incandescent lighting. In this case we have six lamps connected together across the main wires, or leads. As the standard incandescent lamp requires about 110 volts to operate properly, this pressure is maintained across the leads A and B. Each 16-candle-power lamp requires a current of approximately one-half an am-

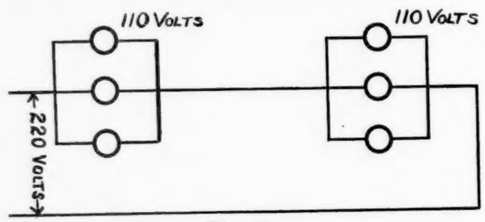


FIG. 9.

pere at a pressure of 110 volts. The six lamps will therefore require one-half multiplied by six, or three amperes, to operate the group. As there are frequently many hundred lamps so connected, it will be seen that while the total pressure of such a system may not exceed 110 volts, the current may reach several hundred amperes in each main circuit. As a matter of fact, the total current output of some of the largest stations operating in this system reaches many thousand amperes.

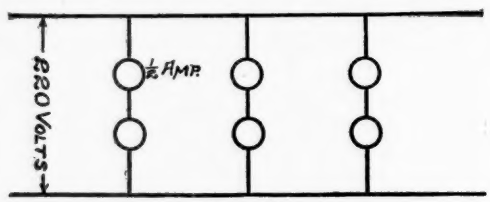
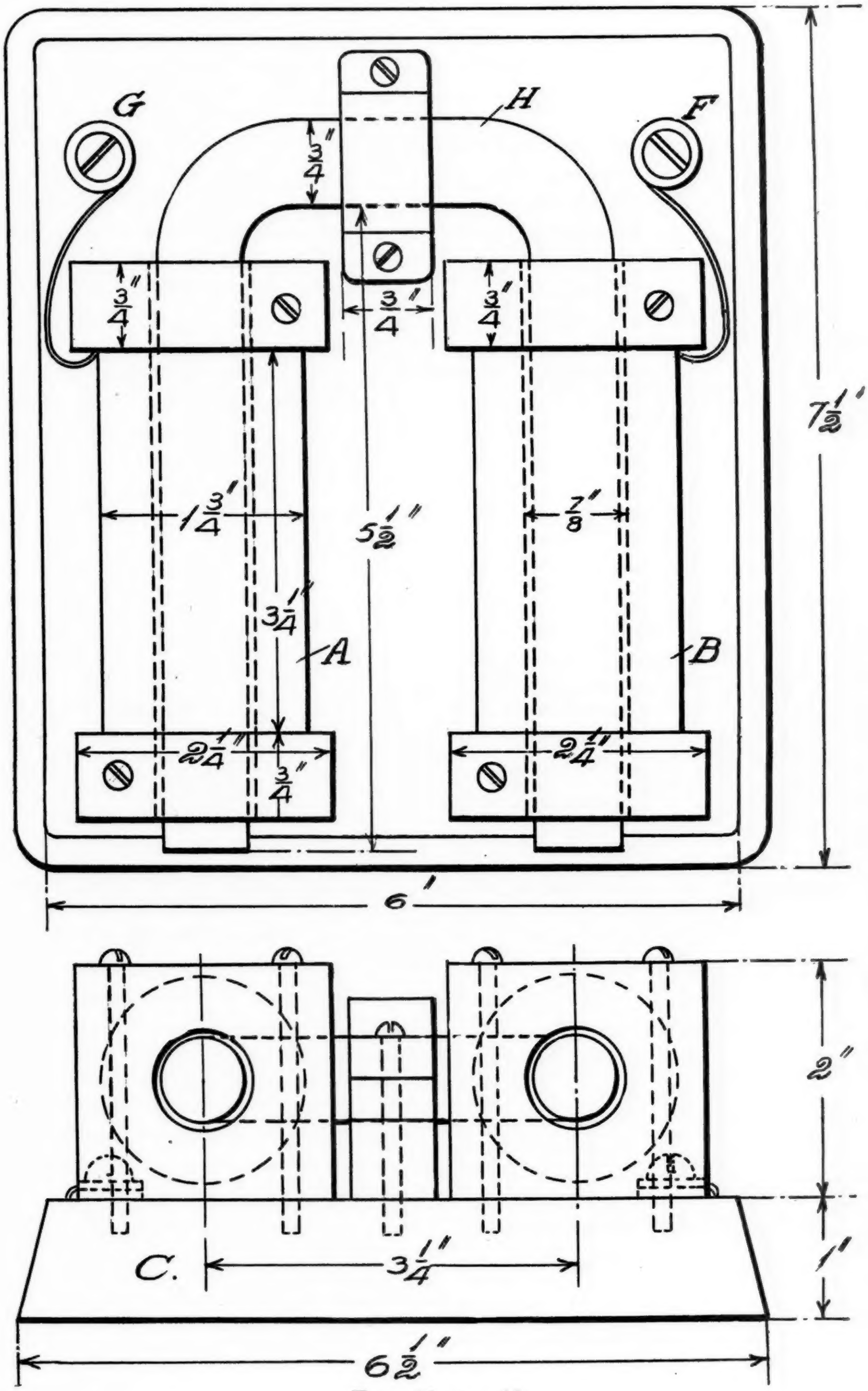


FIG. 10.

The two methods of connection, series and multiple, cover most of the connections used in electrical engineering.

There are two other arrangements of circuits sometimes used, which are illustrated in Figs. 9 and 10, Fig. 9 showing what is termed a series multiple, or series parallel, method connection. In this arrangement it will be seen that the whole circuit consists of a series of groups of lamps, batteries or instruments, the members of each group



Figs. 11 and 12.

being in multiple, while Fig. 10 shows the multiple series system, in which the devices as a whole are connected in multiple, but divided into groups in which the devices of each group are in series with each other. It is of course understood that these methods of connection may be used with any electrical device, whether it be a battery, lamp or other appliance. In most of the experiments to be described, the plain series connection will be found the most desirable.

Figs. 11 and 12 show an electro-magnet of a suitable size to give the best results from the battery described in the previous article. This magnet will be very convenient for making permanent magnets and a variety of experimental work, including a study of magnetism and the magnetic field. The magnet consists of two spools, A and B, of the dimensions shown, securely fastened to a wooden base, C, by means of screws passing through the heads of the coils into the base. It will be noted that the spool-heads are square and thick. This substantial construction is necessary, because the device when completed is quite heavy and is subject to considerable handling. The spool-heads should be sawn from hard wood, and the center holes drilled seven-eighths of an inch in diameter. Two tubes of several turns of heavy manilla paper or cartridge paper, formed around a three-quarter-inch rod, should next be made. These tubes should be glued securely into the heads of the spool, as shown. Care should be taken to see that the heads are all square with each other and the same distance apart. This alignment may be best secured by fastening the spool to a strip of wood while the glue is drying The holes for the fastening screws, and all other holes, should be drilled before the spool is wound. When this has been done, the spools may be mounted on a wooden arbor in the lathe, and wound.

Begin winding by inserting one end of the wire through the inner hole in the head E, and wind the wire on smoothly, layer after layer, until half of the wire has been wound on the spool. If the winding is not sufficiently smooth when the last two layers are being wound, a strip of stiff paper may be fitted around the spool and the last layer wound over the paper, making a smooth finish. The ends should be left long enough to connect to the binding screws, F and G, as shown. Connect the inside end of each coil together, and you may then make the core H. This is made from a three-quarter-inch bar of soft iron bent into the U-shape shown. This core, to give the best results, should be annealed by heating it red hot and allowing it to cool slowly. Do not fasten the coils to the base until the iron core has been made, for if the distance between the arms of the core does not come out according to the sketch, the position of the coils on the base will be altered accordingly. The winding may consist of two pounds of No. 18 B. & S. (Brown & Sharpe) gauge single cotton covered magnet wire. After the magnet has been completed, the coils may be given one or two coats of shellac varnish, and when dry the magnet is ready for use. The iron core should slide freely through the coils, as it will be found necessary to remove it in various experiments. To hold the core firmly in position, when required, two wood strips, hollowed out to fit the core, as shown at H, may be used. These strips, if screwed securely to the base, will hold the core firmly in position.

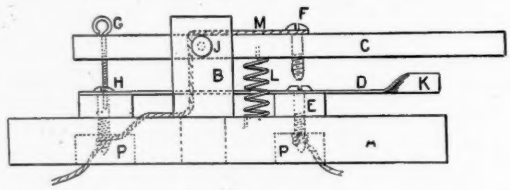


Fig. 13.

Fig. 13 shows a key, or circuit closer, which will be found most convenient for making and breaking the connection of the battery. It should be made as described on page 16, in the November number of this magazine.

Another device for rapidly interrupting the circuit is shown in Fig. 14. This will be found convenient for giving shocks in connection with the electro-magnet, for experiments with induction coils, and a variety of other uses. It is very easily constructed, and the amateur should not neglect to provide himself with such an interrupter. It consists simply of a wooden wheel turned in one piece with its shaft. This wheel is mounted between two uprights on the base B. Before the wheel is taken out of the lathe, a circle should be marked on each side of it, and around this circle a number of wire nails should be driven through the wheel, so as to extend equally on each side. Two flat brass springs provided with connection

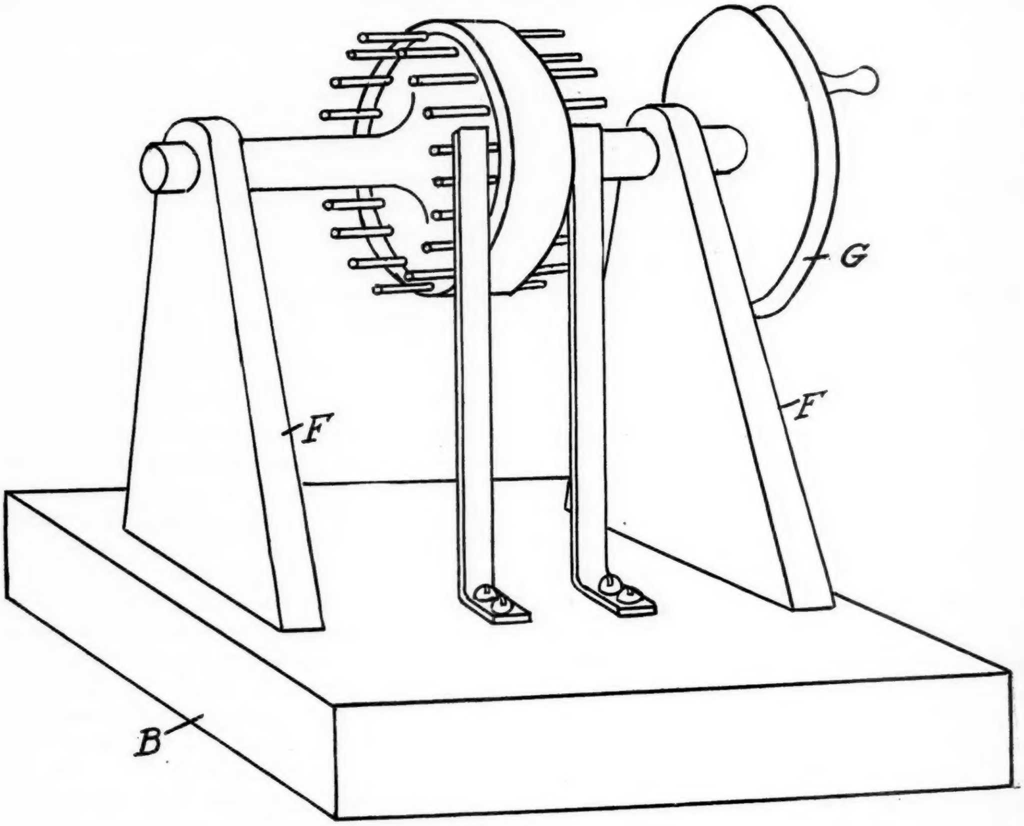


FIG. 14.

screws may be fastened to the base of opposite sides of the wheel, so that they will both bear gently at once on the pin which happens to be at the lower diameter of the wheel, as shown. The wooden shaft on one side of the wheel may be extended through the wooden upright or bearing, F, and provided with a small crank or handwheel, so that it may be easily turned. It will now be seen that as the wheel is revolved, the connection between the springs will alternately be made and broken as the device is operated. It will be found convenient to provide the handwheel G with a groove on its edge, so that, if necessary, it may be driven by a belt by any convenient source of power, such as a small motor run from a battery.

The proper connection for the battery, magnet and key, or circuit closer, is as follows: The wire is run from one pole of the battery to one of the binding posts on the base of the magnet. Another connection is made from the second binding post on the magnet to one of the connections on the key. The remaining connection on the key is connected with the other pole of the battery. In order to preserve the condition of the battery as long as possible, it is important at the conclusion of all experiments that the circuit be left open and the battery plates be removed from the jars. If this is not attended to, the battery will rapidly lose its strength, and solution will require frequent renewal, and the zincs cleaned and amalgamated; *i. e.*, treated with the mercury as described in the preceding article.

The Trans-African telegraph line has experienced interruption caused by elephants breaking down the poles.

HOW I BUILT A STEAM AUTOMOBILE.

J. M. McPhail.

The writer of this article has been requested to tell the readers of Amateur Work how he built a steam-propelled carriage at an expenditure of about three hundred dollars and a year's labor at odd times.

Having seen several of the different makes, and deciding to copy as nearly as possible one of the standard designs and leave the freak carriages to those caring to experiment, I started to take measurements of the different parts from the machines I saw in the streets and at the different exhibitions when they were to be seen. I managed to get all the correct measurements and lines of the standard vehicles.

The hubs were made first and were turned out of bar machine steel and made to be fitted with ball bearings. The cups for the balls were made out of the best tool steel that could be obtained, and were hardened, tempered and ground inside and out and then pressed into the hub. The hubs were drilled with holes for the spokes, and, after being nickel-plated, were ready for the spokes.

The rims were bought from a dealer for a small amount and drilled for the spokes to correspond with the hubs. These are 30″ in diameter and fitted with a 2½″ tire, which latter being built up, made a nice set of wheels, and being fitted with heavy spokes made them very strong.

The axles were procured from a manufacturer of drop forgings. They were turned in a lathe and fitted with the cones for the ball bearings.

The next and hardest part of the work was making the wooden patterns for the different castings of steel, for connecting the frame of steel tubing.

There are so many manufacturers who now make drop forgings, that there is no need of making patterns. Simply buy the forgings and machine them. This is cheaper than making patterns and having them cast.

The frame was designed to have, and fitted with, two long reaches, which strengthen the running gear of the vehicle.

The tubing for the frame of the running gear was 1½″ in diameter and heavy No. 10 gauge. Having cut and bent it to the proper shape, it was brazed into place and filed and finished up. The wheels and elliptical springs were then put on. The running gear was then ready for the body. I purchased the body of a carriage dealer and finished it myself.

A body for a steam vehicle can be bought for from fifteen to twenty-five dollars for a one-seated carriage and thirty to fifty for a double or surrey. This price is in the white, and the finish is extra.

Most of the readers of this article will think that the boiler where the steam is generated is very difficult to make, but in reality it is very simple. The boiler was made from a fourteen-inch piece of copper water-tank and is fifteen inches high, with two steel flanges or rings slipped over the ends, and then taken to a coppersmith and the ends of the copper shell flanged over to fit the steel rings. The two pieces of copper for heads were fourteen inches in diameter, by one-quarter of an inch in thickness. These were first drilled with three hundred half-inch holes and were then riveted on to the shell. The copper tubes, No. 20 gauge, were set in and expanded on the ends so as to make them tight under pressure. The boiler was next wound with three layers of piano wire one-sixteenth of an inch in diameter, which gives great tensile strength. This boiler, on a cold-water test, stood six hundred pounds pressure, and the writer has had three hundred pounds steam pressure and it has held tight.

On the subject of engines, it is useless for an amateur, unless very well equipped, to try and build one, as it takes so many special tools and patterns that, unless one has the time and money, it is a great deal cheaper to buy one. A good one can be procured for about eighty-five dollars, all ready to take steam. The engine should be large enough to furnish about four horse-power at a steam pressure of one hundred and fifty pounds.

The next process was to get a water-tank built to furnish water for the boiler, which was set in the back of the carriage. The one I used holds thirty-five gallons of water. There are also required two tanks to set under the footboard, to hold about nine gallons of gasolene. Also a copper tank to hold air to force gasolene to the burner, and a common bicycle pump to pump up the air pressure.

The next work was the assembling the different parts and fitting the piping to the steam and water gauges and burner for use under boiler. The latter is a stock article and can be procured from

dealers. After everything was assembled and made to operate satisfactorily, the carriage was taken to pieces and the different parts painted and varnished, and the frame enameled the same as a bicycle frame.

The seat was upholstered in black leather, the bright works were nickel-plated, and the carriage again put together on the street as the work of construction was done in the cellar of the writer's house. Water was put into the tank and boiler, gasolene in the fuel tank and everything gotten ready for a start. The burner was lighted, and in a very few minutes there were eighty pounds of steam. The writer then stepped into the carriage, took the throttle in his right hand and the steering lever in the other and gently gave her steam. The carriage immediately started up a small hill and proceeded to the stable under steam. The thrill of delight as the carriage moved off was one of the most pleasant that can be imagined, as it meant that the work had been successful. The carriage was taken out on the road for several nights following and tuned up, and the little adjustments made that were needed, so that, in the short space of a week, it was running smoothly and with very little noise.

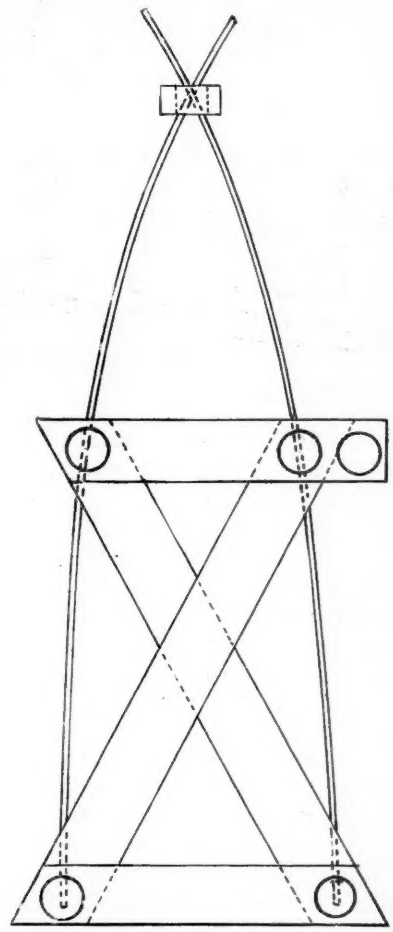
As the writer has said before, such a carriage can be built for three hundred dollars, not counting labor, and will weigh eight hundred pounds and carry three persons. It is one of the most satisfactory investments of time and money I ever made, and I am well satisfied with the results of my labors.

A PLATE-RACK.

James F. Rugg.

The plate-rack here described is an exceptionally useful kitchen utensil, and much prized by those who have used it. The labor of dish-wiping is avoided through the use of such a rack, and housekeepers will welcome anything that will dispense with this drudgery. The plates, having been washed, are put into quite hot rinsing water and thoroughly rinsed. They are then put into the rack and allowed to remain there until dry. This takes but a few minutes, the heat remaining in the dish when taken from the rinsing water affecting this. The top part should be filled first, to allow the dishes to drain before putting dishes under them. Dishes, and especially glassware, so dried, will have a fine polish, satisfactory to the most scrupulous housekeeper.

The materials required for a rack that will hold 36 dishes and an equal number of cups or tumblers are: 4 pieces clear birch or maple 24″ long, 1½″ wide and ⅞″ thick, and one piece 36″ long; 5 round pieces, 36″ long and 1″ diameter, 36

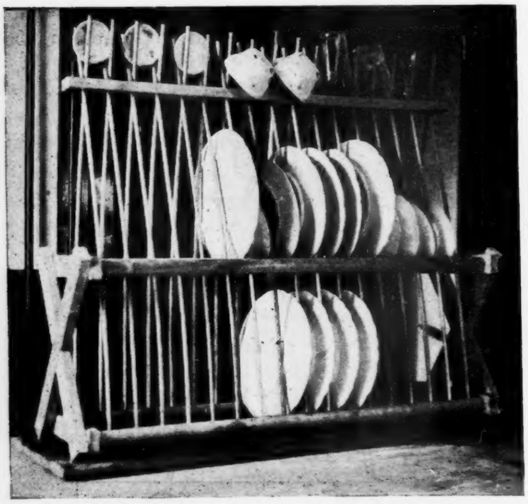


pieces doweling 30″ long and ¼″ diameter. The rack above illustrated was made in a hurry, and the X pieces were not halved to the crosspieces, nor the ends beveled. It is desirable to do this, as it makes a neater-looking rack.

If one is not familiar with wood-working, it will be advisable, before cutting out the pieces, to make a full-sized drawing of the end section

as here given on one-quarter scale. The joints can then be laid out accurately and the work proceed more rapidly.

The X pieces are 14⅝″ long, allowing ⅞″ on each end for bevels. The bottom crosspiece is



9¼″ long and the top crosspiece 8⅜″ long. A 1″ hole is bored in each end of the bottom piece, the centers being 6½″ apart and 1⅛″ from each end. In the top piece three holes are bored, two of them 5″ between centers, the one on the beveled end being 1⅛″ from the end, and the other 2⅛″. The center of the third hole is 1″ from the square end. The bit should be sharp and care used in boring to prevent splitting the wood. The halves are now cut in the X pieces and crosspieces, those on the latter being on the inside. They are ½″ deep and should be accurate, so as to bring the surfaces of all the pieces flush when done. When these are completed, bore the holes in the X pieces to match the holes in the crosspieces. The round pieces that run lengthwise will then fit all right.

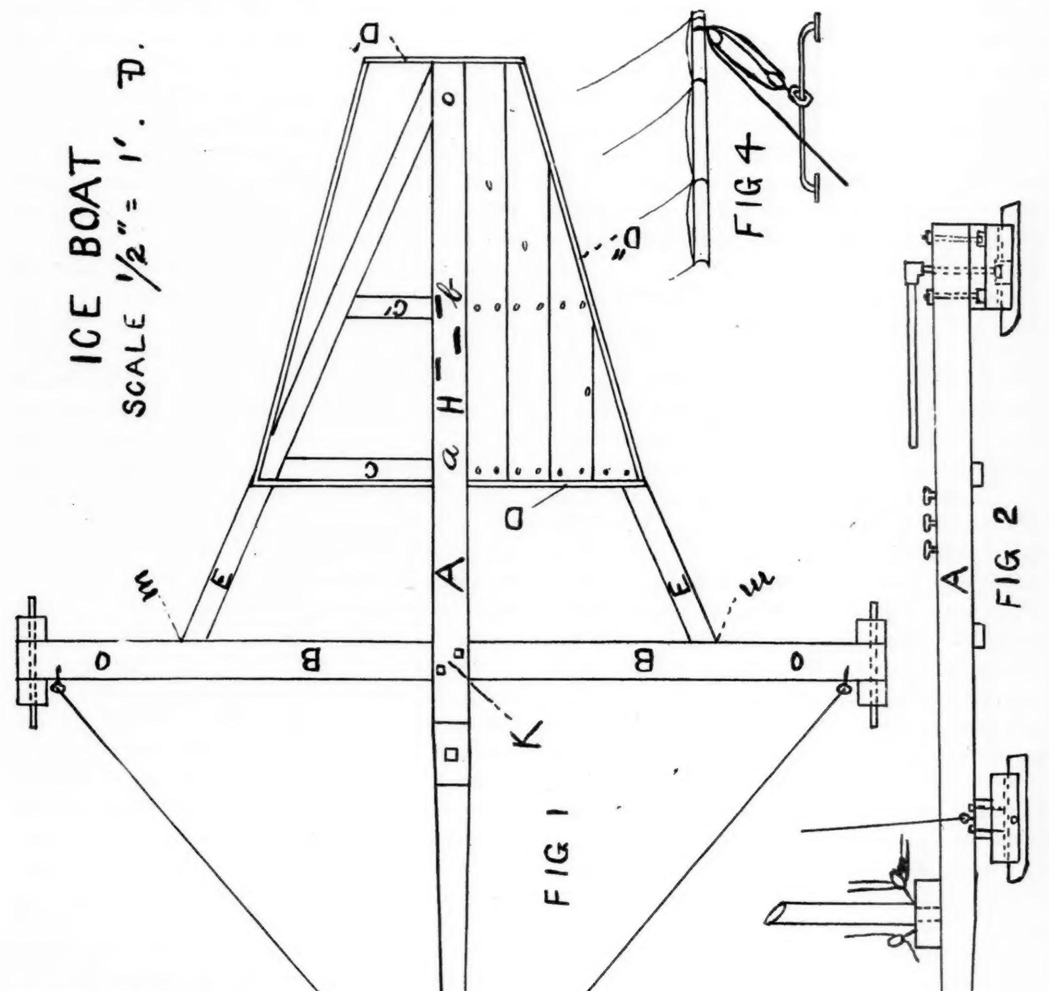
The round pieces are now bored with ¼″ holes to receive the dowel pieces. The holes in the two bottom ones are not bored through, about a ¼″ of wood being left. A pencil mark should be made along these pieces to insure getting the holes in line. Also care should be used to bore the holes in the same direction. A piece of dowel put in the first hole bored will serve as a guide for the rest. The holes are 1⅞″ between centers, and 1″ extra should be allowed on each end for fitting to the holes in the end pieces. No holes are bored in the upper outside round piece, this being used only when the rack is supported on a wall and rests on screw-hooks in the wall. In the upper flat piece, through which the dowels cross, bore ¾″ holes, 1⅞″ between centers, the center of the end holes being 1⅞″ from the end.

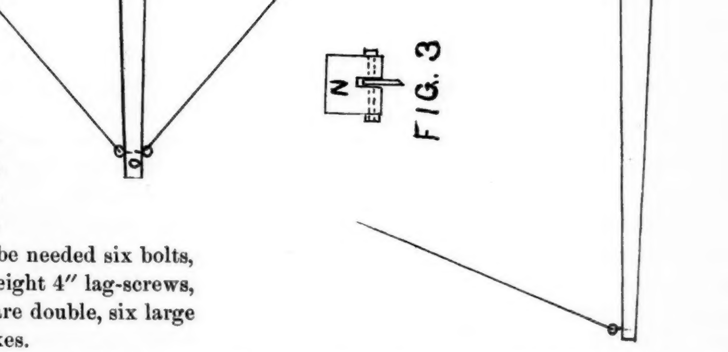
The rack is now ready to be put together. The round and end pieces are put together and glued. Two dowels are put in the end holes at each end, the tops brought together, and the top piece slipped over them and pressed down to the proper place. The dowels for the other holes are then easily placed. Beneath the rack should be a drain board. This is 9″ wide and 36″ long, with a ¼″ square strip along the sides and one end, the other being over the sink or a dish, into which flows the water from the plates. This drain board is sometimes covered with zinc, but a hard enamel paint will answer nicely. The rack is shellacked. The capacity of the rack may be increased or diminished by varying the number of partitions.

HOW TO BUILD AN ICE-BOAT.

A. S. Whittemore.

When a boy builds anything he generally wishes to know how to construct it at the least expense. In building an ice-boat he would like it strong, durable, and at the same time to cost little. The following plan for building an ice-boat is from actual experience, and if used will enable any one of but little skill to build a very serviceable boat. In building the boat from this diagram, the lumber required is: a spruce plank, A, 4″ x 5″ and 13′ long, for the backbone, a spruce plank, B, 2″ x 5″ and 10′ 4″ long for the crossbar, three pieces spruce, 2″ x 3″ and 7′ 6″ long for the braces, E and C and C′; C being 4′ long and C′ being 2′ 6″ long. Also four boards, D, 4″ wide and 1″ thick for the edging of deck, D being 4′ 9″ long, D′ 2′ long and D″ each 5′ 2″ long. The boards for the flooring should be of match pine ¾″ thick, and 35 running feet of 6″ width will be needed. Three





4" x 4" oak blocks 1' long are required for runner-blocks. These should have grooves cut $\frac{1}{4}$" wide and 2" deep lengthwise through the center for the steel runners. This can be done at the mill when the lumber is purchased. There will be needed six bolts, 8" x 1", four large eye-bolts, eight 4" lag-screws, seven pulleys, three of which are double, six large screw-eyes, wire nails and spikes.

The plank A for the backbone should be tapered from a point 5' from the bow end down to a thickness of 2" x 2" at end, this tapered end serving as the bowsprit. This should also be done at the lumber mill.

The work of framing begins with attaching the

crosspiece B to the backbone. Find the middle of crosspiece B, then, placing it on its wide side under the backbone A, bolt it on at K, the center of which is 6′ from the bow end. With lag-screws screw the planks E, which have been properly beveled, to the crossbar B at M, M, 3′ from the backbone, and again to the backbone and to each other where they meet beneath A at stern end. These two planks greatly strengthen the body of the boat and should be carefully fitted.

Next fit the crosspieces C and C′ and firmly attach to pieces E and A with wire spikes, taking care not to spring the pieces E while doing it. C is 1′ 11″ from B, and C′ is 1′ 8″ from C. The flooring is then sawed out and nailed to pieces C and E, leaving ¾″ lap beyond C through which to nail the side pieces to deck. The side pieces D are then nailed together and then attached to deck by being nailed through the flooring. The frame should be turned over or supported on horses to do this. Eight inches forward from the crossbar B attach a spruce block with lag-screws to the backbone. This should be 8″ long, 4″ wide and 3″ thick, and have in the center a hole 2″ square in which to step the mast.

For the runners procure three pieces of carriage spring steel, each 18″ long, 2½″ wide and $\frac{3}{16}$″ thick. In the middle have a ⅜″ hole punched or drilled, the center of which is ¾″ from the upper edge. Grind two of them down as shown in Fig. 3 with the cutting edge outside. The third one should be ground on each side to give a V-shaped edge, this being for the steering runner. The front ends should be rounded like a sled runner. If a spring steel cannot be obtained, old skates ground as directed will answer the purpose. A ⅜″ hole is bored in each runner-block, the centers being 1″ from lower edge, to receive the bolts holding the runners. The runners are then bolted into the blocks. At each end of the crossbar B, bolt the front runner-blocks, seeing that they are parallel with the backbone.

For the tiller take an iron bolt 1″ in diameter and 12″ long, having a square head, which should be tightly fitted into a hole cut in the block of the steering runner and put in before placing the runner in position. Bore a 1″ hole down through the backbone, the center being 5″ from the end. Insert the bolt of the steering runner. For the handle of the tiller, a piece of 1″ iron water-pipe 2′ long is required. On the end of the pipe have a thread cut and an L connection fitted, which latter will also fit the end of the runner bolt. A ¼″ hole should be drilled through the bolt and L, and a small bolt inserted to prevent the tiller from turning on the bolt. Three cleats are fastened to the backbone at H for the halyards, and one eye-bolt at the end of the bowsprit A, and one each on the crossbar at O and O′.

For the mast, secure a spruce pole 12′ long and 3″ in diameter at the base. For the boom, a spruce pole 11′ long and 2½″ in diameter at the mast end. For the gaff, a spruce pole 8′ long and 2″ in diameter. Fit strong V-shaped oak jaws at the throats of boom and gaff. The sail is of unbleached cotton, 11′ on the boom, 10′ on the mast and 8′ on the gaff. It should be hemmed at top and bottom, and also along the mast edge if the seams are run parallel with the slant of the outside edge of sail. It is desirable to have a stout line, clothesline will do, inside the hem to prevent the sail from tearing. Have the gaff peak up an angle of 60 degrees. The sail is fastened to the boom and gaff with loops of rope run through eyelets in the sail, and to the mast by rings of wood or heavy wire tied to eyelets in the sail. Make a jib 4′ 3″ on the base and 9′ high. This will run on the jib stay by stringing on the jib 1″ iron rings about 1′ apart. Make the mast stays of hemp clothesline running from the eye-bolts O O O to the top of the mast, fastening them in screw-eyes there placed, though an eye-band would be better if it can easily be obtained. Lash two pulleys 6″ from the top of the mast, one on the stem side for the throat halyards and one on bow side for jib, and another at the top for the peak halyard. The halyards are tied to the jib and gaff, and are the ropes used to hoist the sails, the peak halyard being the one running to the peak of the gaff, and the throat halyard the one running to foot of gaff. The jib requires but one. Cotton clothesline will do for the halyards.

To the backbone at the base of the mast drive in two staples, to which tie one single pulley for jib halyards and one double pulley for main-sheet halyards. To the piece D′ at stern, a horse for main-sheet traveler may be attached. (Fig. 4.) This is useful when beating to windward. The pulley or traveler ring should be tied on to facilitate unshipping the rigging.

FIRST WORK WITH A CAMERA.

FREDERICK A. DRAPER.

THE first camera one possesses is generally the subject of considerable perplexity on the part of the owner. Focusing, exposure, plates, development, printing and numerous other questions rise to confuse, and their solution too often means the loss of valuable views that cannot be replaced. A little previous study into the conditions governing the use of a camera is desirable before beginning actual work for the first time.

A few words as to the basic principles. The rays of light that should enter the camera should be *reflected* from the object we desire to photograph. This requires that the direct rays of the sun should come from the back or side of the camera. By using great care, shielding the lens and other devices, a view may be taken when the lens faces nearly towards the sun; but this should only be done when it is impossible to get the view with the sun in a more favorable position. Never point the camera, as the writer has seen many a beginner do, directly towards the sun, as the only result will be disappointment. Use care in the selection of the view. Unless possessed of a long purse, promiscuous snapping the shutter will entail considerable expense and procure few views worth preserving. Friends are always willing to receive gratis several prints, especially if a good negative be secured. Some cases of this kind you really want, but many others were better dispensed with. Make it a point to do your best with each exposure, and you will soon find your work is good, and done with increasing ease. Study the artistic make-up of the subject, whether it be landscape, group or interior. A slight change of position or grouping may often greatly improve the result.

If plates are used, select one of the standard brands and stick to it until you know its workings thoroughly. Constantly changing the brand and kind of plate used, leads only to confusion. Make a record, in a book kept for that purpose only, of the time of exposure, kind of day, bright, dull, cloudy, etc., and by comparison learn the cause of the first errors. You will soon be able to prevent their recurrence. Keep the filled plate-holders covered from the direct rays of the sun. A foggy plate is often caused by laying the plate-holder in the bright sun while adjusting the camera. When removing the slide in the plate-holder, cover that portion of camera with a focusing or some other black cloth so the sun will not shine upon it. See that the lens is clean. A piece of chamois skin is the best thing to clean the lens with. Never use silk.

The amount of light admitted to the camera is varied by the diaphragm. On a bright day, a smaller stop, as it is called, may be used, than on a dull, cloudy day. The smaller the stop, the longer the exposure required and the sharper definition secured.

If possible, have your own dark room and do your own developing. This requires a ruby lamp, and one with both ruby and orange glass should be used. See that the room is absolutely light-proof. Dust your plate-holder and plates with a soft brush when loading. Make your first trials at developing with views that can again be taken if you fail with them. The developing formulæ given by the maker of the plates you are using will be satisfactory. Use fresh chemicals, also fresh plates. Buy your supplies of a reputable dealer, even if the cost is a little more than at some bargain-counter sale. Old plates and old chemicals are expensive in the results, even if you have them given to you.

Label your different bottles, pans, etc., and use each one only as directed. A mixture of chemicals in the same tray, even if only traces be present, is extremely likely to ruin a negative. The developer will flow more evenly if the plate has been previously wet with clean water. The developer, when first applied to the plate, should sweep over it in a wave as quickly as possible, and be kept rocking until development is well advanced. The usual faults of the novice are over-exposure and under-development. Keep these points in mind during your early work. In your first work, study carefully what you have to do, until you have it clearly in mind.

The many excellent printing papers now available, accompanied with complete directions for working, make unnecessary any instruction regarding the common kinds of prints. As progress is made, the inclinations of the worker will lead to experiments with more complicated processes, and when that time arrives, these remarks will be no longer useful.

AMATEUR WORK

85 WATER ST., BOSTON

F. A. DRAPER . . . . Publisher

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month, for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume 10 cents.

TO ADVERTISERS

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

JANUARY, 1902

Contents

ELEMENTS OF SUCCESS.

It has been said that the American youth has twenty things begun but only one done. This statement is undoubtedly much exaggerated, but it is a fact that too many attempts are made that are never completed. The lack of proper consideration of what is to be done and the means to do it, is probably the chief cause of this condition. It were better not to begin any work than to begin it and not complete it because it is no longer interesting. Should any one find a growing tendency on his part to do careless or incomplete work, every effort should be made to overcome it. The harmful effects of such a practice are many and permanent. A weak and vacillating character ruins many a man, no matter how great his abilities may be. The steady, thorough worker is the one who, in these days of large industrial enterprises, occupies the position of responsibility. This is because he can be depended upon to do what is required of him in the way and when it is wanted. This ability on his part was developed in younger days and became sufficiently characteristic of his work, so that it was recognized and thus procured his advancement. Our young readers who hope to succeed in their chosen vocation will do so only by acquiring the habit of being thoughtful, thorough and persistent in what they attempt now.

The successful transmission of signals across the Atlantic Ocean by wireless telegraphy, which was accomplished by the Italian inventor, Guglielmo Marconi, on Wednesday, Dec. 11, is entitled to rank among the notable achievements of the present century. The success of wireless telegraphy over moderate distances has justified the hope that much greater spaces would eventually be spanned by it, but the sudden leap from transmission over a hundred miles or so to the 1,800 miles distance from Newfoundland to Cornwall, was a surprise to even the most sanguine.

A practical illustration of the use of the telephone as part of a diver's equipment is being given at the exposition which is being held at the Chicago Coliseum this week. A telephone is attached to the helmet of a diver, who is under water for a number of hours. Visitors to the show can converse with the man, and the device is proving quite an attraction. The telephone was used by divers in examining the wreck of the "Idler," a private yacht from Cleveland, which went down on the lakes during the last season, thus enabling the men who were searching for bodies to keep those above promptly informed as to results.

MECHANICAL DRAWING.

EARNEST T. CHILD.

III.

WORKING DRAWINGS.

INCIDENTAL to the practice work which the student must not neglect, it will be well to study as to the detail and general make-up of drawings. The first question that will naturally occur is: the class of line to use. The first tendency will be to use very light lines; but this should be avoided, especially in case the drawing is to be

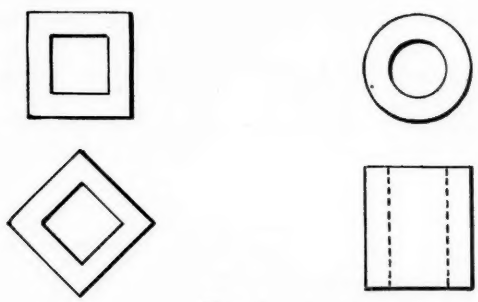


FIG. 1.

blue-printed, as fine lines are very apt to print out. The full lines should be about one-fiftieth of an inch wide, and the dotted lines about two-thirds as wide as the full. Those shown on page 41 in the December number are of the proper weight. It will be seen that shade lines are not used in this case. For regular shop work it is not generally found expedient to use shade lines, as they add to the cost of the drawing, and do not ordinarily add enough to the clearness of the drawing to pay for the outlay. For this reason, the drawings which will be given hereafter will omit shade lines. It will not do to entirely condemn the use of shade lines, as there are instances where a drawing will be incomplete without them. Our work will not be complete without a few words on this subject.

In using shade lines on a drawing, it is generally assumed that the light is coming from the upper left-hand corner of the sheet. This will cause shadows to be cast on the lower and right-hand lines. In case one surface is nearer the observer than another, the lower and right-hand lines of the nearest surface will be shaded. When two surfaces representing different pieces are flush, the dividing line should not be shaded. In some instances it will be found very difficult to determine just which lines should be shaded, but the general rule given above will almost always apply. Shade the lower right-hand quadrant of outside circles and the upper left-hand quadrant of inside circles, and always keep the shading outside of the surface which they bound. Shade lines or circles should be tapered off gradually to the regular weight of line. When shade lines are used, the light lines should be much finer than one-fiftieth of an inch. (See Fig. 1.) The various classes of conventional lines are shown by Fig. 2. No. 1 shows a fine full line suitable for drawing when using shade lines of the width shown by No. 2. The latter is the proper width of line where shading is omitted and the work has to be blue-printed. No. 3 shows a dotted line, No. 4 a dash line, No. 5 a dot-and-dash line, and No. 6 a double dot-and-dash line. It will be noted that Nos. 3 to 6 are finer than No. 2. This adds clearness and strength to the drawing.

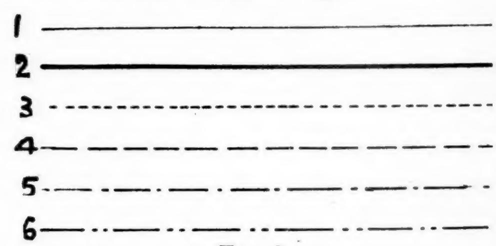


FIG. 2.

In expressing on the drawing the character of a surface other than a plane, it is often necessary to use what is called line shading. This is particularly effective in showing curved surfaces. To show a cylindrical surface (Fig. 3), draw parallel lines quite close together at the outside edge, but rapidly growing farther apart, until they stop

about one-third way across the cylinder. The effect is strengthened by using heavier lines on the lower portion of the cylinder. In a similar way a sphere or a cone may be shown. A plane at an angle may be shown by parallel lines spread equidistant, one from the other, but this is seldom used to any great extent, as it is very apt to confuse the drawing.

A knurled surface is one which is cut by diagonal cross-grooves, to enable a firm hold to be secured, and is used particularly on hand check-nuts and cylindrical nuts. This is shown by diagonal cross-lines, and if the surface is a cylinder, he spacing is changed to give the effect of a round object (Fig. 4).

Working drawings are of several classes.

First.— Outline draw-

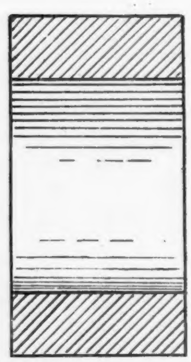


Fig. 3.

ings, giving the general outline dimensions and space occupied, but not showing any detail or dotted work to speak of.

Second.—Assembly or erection drawings, showing the entire machine, with all its parts in their proper positions. This class of drawings will con-

Fig. 4.

tain a great deal of detail and dotted work, as often the greater part of the working mechanism will be concealed behind some part of the frame or some other part.

Third.—Detail drawings, showing to a large scale the individual parts of the machine, with all the information necessary for their completion. It is allowable to show several details on a single sheet, and in the case of steel forgings it is customary to show several on one sheet.

Fourth.— Some machines are so complicated that it is necessary to make a separate sheet showing all the special bolts used in their construction, together with a bolt list, and in some drawing-rooms it is customary to make motion diagrams for each machine; but these are rather outside of our present field, and are only mentioned here incidentally.

In making drawings it is often impossible to draw them full, or finish, size, and accordingly we must adopt some scale, so that a large object may

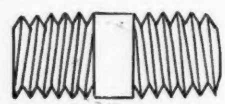


Fig. 5.

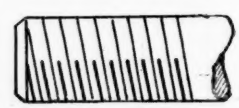


Fig. 6.

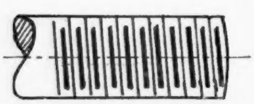


Fig. 7.

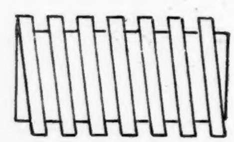


Fig. 8.

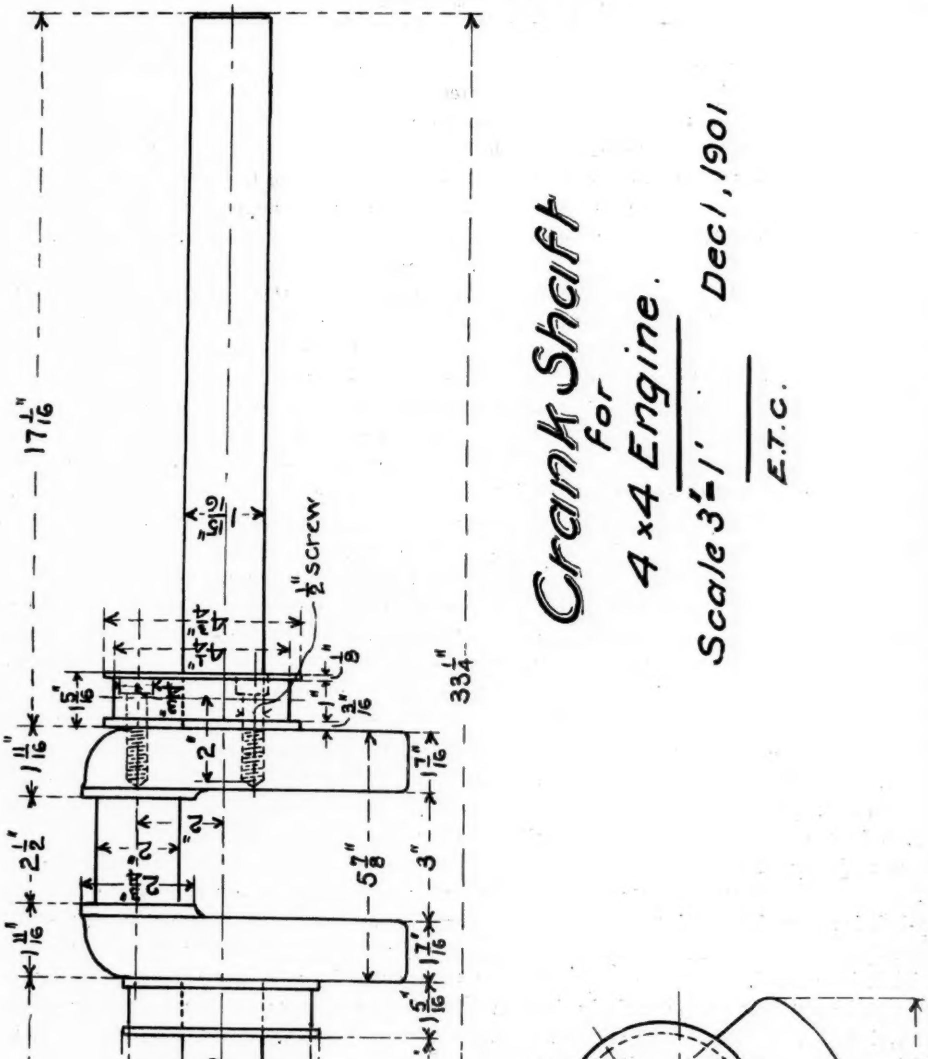
be shown in a comparatively small space. That is, one inch on the drawing will be made equal to so many feet of the actual object.

Referring to the November issue, page 15, we find given the common scales.

It is customary to make outline drawings in the proportion of $\frac{1}{4}''$ to $1'$, to $\frac{1}{2}''$ to $1'$; erection drawings on $1''$ to $1'$, to $1\frac{1}{2}''$ to $1'$; and detail drawings on $3''$ to $1'$, to full size; but these scales are often varied, a great deal depending on the size of the sheet, the number of screws, and the size of the object to be shown. The delineation of nuts, bolts and screw threads varies greatly, some draftsmen always showing the threads in detail, and others merely showing them by conventional lines.

The student should first be made acquainted with the various styles of thread used, and also with the different classes of bolts, screws, etc.

The most common thread is the V type. A


Crank Shaft
for
4 x 4 Engine.
Scale 3" = 1'
Dec 1, 1901
E.T.C.
17 1/16"
33 1/4"
10 5/16"
9"
2 1/2"
5 7/8"
3"
1/2" screw
7 3/8"

right-hand thread is one which, when turned clockwise, will screw in, and a left-hand thread screws in when turned to the left. A double thread is one having two distinct threads following each other around the screw, and the pitch, or distance which the screw moves forward with one revolution, is double that of a single thread of the same size.

Fig. 5 shows a V thread drawn out in detail, one end showing a right-hand thread, the other a left-hand thread.

Fig. 6 shows the conventional method used for showing a V thread. If the screw is concealed, the lines will be shown dotted.

Fig. 7 shows a conventiona double thread. The ends of the screws are either rounded, as in Fig. 6, or chamfered, as in Fig. 7.

Fig. 8 shows a conventional square thread. A thread of this kind is extremely difficult to draw in detail, as it requires a full knowledge of descriptive geometry, and it will not be necessary to show it here, as it is rarely used in practice. If any long piece is to be threaded throughout its entire length, the threading may be shown at the ends only, and the fact that it is to be threaded throughout, covered by a note or by the use of a dimension line with "Thread" marked in place of a figure. Sometimes the outline of a screw is shown, as in Fig. 5, with the cross-lines omitted, but Fig. 6 is the most common method used. The great majority of bolts are fitted with V threads.

A tap-bolt is screwed direct into a tapped hole, and generally does not extend through the material into which it is screwed.

A through or nut bolt passes entirely through the material which it holds, being secured by a nut. It is customary to allow a thickness of nut equal to the diameter of bolt, and the extreme diameter of a hexagonal nut is approximately twice the diameter of the bolt.

A set-screw has a square head, the short diameter of which is equal to the diameter of the screw. The end of the screw is made nearly flat, to insure a good hold, as it is used for securing pulleys, collars, etc., to moving shafting. There are other types of bolts and screws used, which need not be described here. The method used in showing tapped holes is practically the same as for screws. The end view of a tapped hole may be shown by two concentric circles: by a full circle with a dotted one outside of it, or by a single circle with the word "Tap" written in, giving the size of the hole. It will be well for the student to make a practice sheet covering the work described above, and shown by the accompanying figures, in order to become familiar with the various classes of work described.

As stated in the December editorial, it is the intuition to use the details of a small upright engine, and finally the assembly of same as practice sheets, to be used in connection with our talks on mechanical drawing. One or more of the details will be presented with each number, giving the student sufficient work to occupy his spare time between the successive issues. These working drawings will be introduced in connection with the descriptive text, and will be illustrative of the work required in actual practice.

The detail given herewith shows the crank shaft with governor pulley on the left of the crank, and the eccentric on the right of the crank. The former is shrunk on to the shaft, and the latter is secured by means of two $\frac{1}{2}''$ round-head countersunk screws. It will be seen that the crank pin is slightly larger in diameter than the shaft.

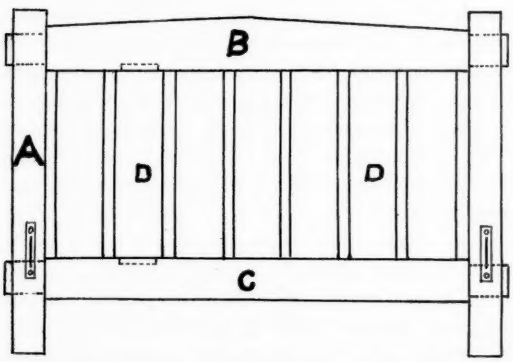
Our thanks to *Modern Machinery* for the review of Amateur Work published in the December issue of that magazine. It must have reached many readers, as the requests we received for sample copies in which this review was mentioned were quite numerous. We must, however, take exceptions to the limitations placed upon the word "amateur," which Worcester defines as "a lover of any art or science, though not a professor of it." It is for those who engage in work for the love of it, or the pleasure derived from it, that Amateur Work is published, and while most of the topics will be treated in an elemental way, the scope of the magazine is not restricted to this class. The professional worker already has numerous magazines at his command, *Modern Machinery* being an example. It is filled with excellent reading for mechanics, well illustrated, and should be helpful to any progressive workman. Published monthly by Modern Machinery Publishing Company, 810 Security Building, Chicago. $1.00 a year.

OLD DUTCH FURNITURE.

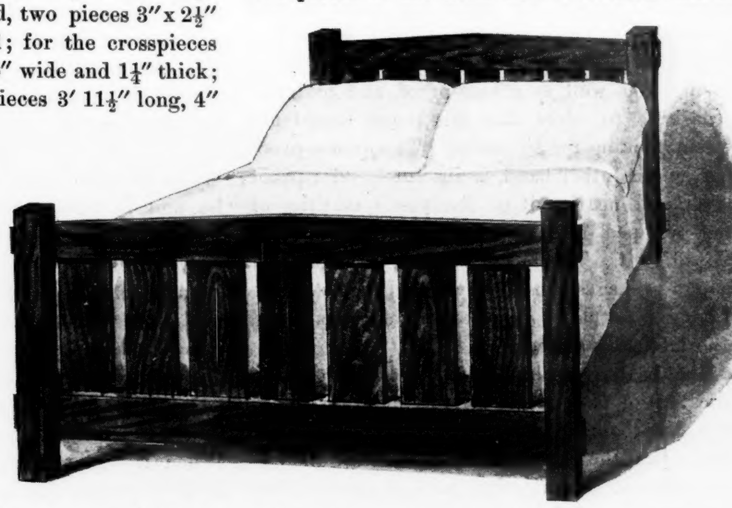
JOHN F. ADAMS.

III. A BOY'S BED.

THE bed here described is suitable for a boy's room; and a boy who is somewhat familiar with the use of wood-working tools would have no difficulty in making one. The necessary lumber,



selected oak, is, for the posts A, two pieces 3″ x 2½″ and 36″ long for headboard, two pieces 3″ x 2½″ and 32″ long for footboard; for the crosspieces B, two pieces 3′ 11½″ long, 5″ wide and 1¼″ thick; for the crosspieces C, two pieces 3′ 11½″ long, 4″ wide and 1¼″ thick; for the upright pieces D on headboard, seven pieces 22½″ long, 4½″ wide, and ½″ thick; for the footboard they are 18½″ long. Also two boards 6′ 2″ long, 6″ wide and ¾″ thick for sideboards, and two strips the same length and ¾″ square, to go on inside of sideboards to hold the slats. Eight slats of pine or spruce 3′ 6″ long, 2½″ wide and ⅞″ thick are needed. A full-width bed can be made by lengthening pieces B and C and increasing the width of pieces D.



The posts are first mortised to receive the tenons of the crosspieces, as shown in Fig. 2, which is on the scale ¾″ to 1′. These mortises are ¾″ wide and 3″ long, and cut clear through the centers of the posts. The top of mortises for crosspiece B is 2″ from end of post. The bottom of mortises for crosspieces C is 5½″ from bottom of posts. The posts A are 3′ 4″ apart, the tenons on crosspieces being 3¾″ long, 3″ wide and ¾″ thick.

The pieces B rise to the center, being 4″ at the ends and 5″ in the center. This tapering can best be done at the mill. The mortises are then cut in the crosspieces to receive the tenons on pieces D. These mortises are 3½″ long, ½″ wide and ⅝″ deep, the pieces D fitting them by sawing out of each corner a piece ½″ square. The ends of the two mortises nearest the posts A are 1½″ from A. It is well to mark out the mortises with a pencil before commencing to cut them, to ensure getting them correctly placed. When all the mortises and tenons are cut, fit the pieces D into the crosspieces and then put on the posts, each joint being glued. The wood should not be cold or damp when being glued.

The side pieces are plain boards with the 1″ square strips screwed to the lower inside edge to hold the bed-slats. The method of fastening the side pieces to the head and footboards are left optional, being dependent upon what can be purchased at the local hardware store. The various devices for this purpose are quite similar and easily applied.

The bed being completed, it is sandpapered smooth, and then given a coat of very dark stain, and then dull polished. Do not varnish or shellac, as a bright surface is not desirable for this style of furniture.

DIVERSITY OF THE MODERN USES OF PAPER.

It used to be said that there was nothing that could not be made out of leather. The same thing is now said of paper. From water mains, rifle-barrels and window panes, to clothing, tablecloths and napkins, the range of articles into which paper is squeezed, spun and chemically wrought, is bewildering. Further than that, the range of uses to which paper is applied is increasing rapidly. The United States are now the greatest producers of paper in the world. The export trade in paper has, however, not developed as rapidly as domestic production, for the reason that the demands of the home market have increased even faster than the capacity of manufacturers to supply them.

One of the most valuable of new forms of paper placed upon the market is a grease-proof paper, which is superior to any so far produced for the use it is put to. One of the uses of this grease-proof paper abroad is for the wrapping of butter for shipment. While there is plenty of merely grease-proof paper now made here, that is used extensively for the wrapping of hams, bacon and similar food products, it has not the merit of being odor-proof as well as grease-proof, and butter is so sensitive to odors that this paper would not serve in packing for shipment. The grease-proof paper, on the other hand, is absolutely odor-proof as well, and nearly all of the vast quantities of butter shipped from Denmark to England are wrapped in it. The butter reaches Great Britain in pound packages, closely enveloped in the grease and odor proof paper — packages that in a sense are hermetically sealed.

Probably the very latest commercial fact in the application of paper is in the way of fireproofing. Paper fireproofing, among other advantages, has this one, that the chemicals used penetrate the entire texture of the material, and are absorbed by it before it is rolled into any thickness that may be required, thus making them much more effective than when wood itself is treated with them. The paper wood thus produced is as hard as wood itself, is susceptible of brilliant polish and any variety of decorative treatment, is vastly lighter, perfectly adjustable and absolutely fireproof. The erection of skyscrapers necessitated a very serious study of fireproof materials and the fireproofing treatment of wood, and the result is that paper is coming very largely into use in all cases where woodwork has to be used. It is particularly adaptable for ceilings and is coming into great popularity for that purpose. The material has been adopted for the finishing of the interiors of warships, and the Pennsylvania Railroad Company is using it very extensively on the head lining or ceilings of passenger cars. The material commonly used for this purpose, being heavily treated with oils, is highly inflammable, and the adoption of the paper fireproofing material is only another precaution for the safety of passengers. In addition to the Pennsylvania road, the New York Central also, it is understood, is considering the adoption of the same material for the interiors of its passenger cars.

As for articles of daily use that are now made of paper, their number is surprisingly large. Eliminating such things as car-wheels, in which paper long ago demonstrated its superiority over steel; the water-buckets, the covering for hayricks, and other similar articles long of familiar use, there are hats, caps and clothing. In Detroit there is a concern which is doing a large and very lucrative business in the manufacture of paper clothing. Paper, of course, as demonstrated in the water-buckets, can be made almost as impervious to water as India rubber itself, and combined with layers of thin cloth a material is made which can be and is put into undershirts, waistcoats and jackets, which present a good appearance and are very durable.

In dress linings, skirt linings, coat linings and in facings, paper cloth is coming more and more into use, and is giving very good satisfaction. Good-looking and very durable hats are made of paper, and paper soles and heels for boots and shoes of the cheaper grades have long been in use. When it was said above that rifle-barrels were made of paper, only the literal fact was stated, although the paper rifle is not practical, for various reasons, among others the cost. It stood the strain of firing perfectly, but was made and considered only as a curiosity, illustrative of paper possibilities. Water mains made of paper, however, not only are a practical possibility, but are in actual use. Where the conditions are such as to warrant the very considerable extra expense of paper water mains,— as, for instance, where, from the nature

of the bed in which they must lie, cast-iron mains would speedily oxidize,—paper water mains, costly as they are, become a matter of economy and are very generally used. Window panes of paper, likewise, are used in cases where there are such constant vibrations or such sudden jars as would break glass. By a chemical process paper may be made so translucent that a printed page can be read through it with perfect ease. Put in a window frame, it gives a soft light sufficient to illuminate a room for nearly all purposes not requiring a particularly strong, clear light, although objects seen through a paper window pane are seen as through a glass, darkly.

Waterproofs of paper are made in considerable numbers. The material consists of a lining of cloth in the middle with a coating of waterproof paper on both sides. Nearly all articles formerly in leather are now made of paper,— such as suit-cases, traveling-bags, etc.,—and so successful is the imitation, that a man who had himself been in the paper business for nine years bought an article of this kind in London recently under the full conviction that it was leather he was purchasing.

For all purposes of laboratory filtering, paper is superseding every other appliance, and there is in this State a large plant which is doing a very profitable business in manufacturing nothing but filter paper.

Along the line of recent inventions is a process for spinning paper into a fine thread which can not only be used for sewing, but out of which a very beautiful fabric can be woven. Specimens of tablecloths and napkins made by this process were exhibited in this city recently which compared very well in appearance with fine articles of linen. The process at present developed is pronounced by paper experts to be altogether too expensive for practical purposes, although it is easily within the possibilities that the day is not so very far distant when we will be using paper table linen. Still another freak exhibition of what can be done with paper was the production of a paper axe with an edge so hard and fine that it could be used for cutting. One of the recent and very successful applications of paper is in its use as an insulating cover for electric wires.—*American Exporter.*

The $200 automobile is still some time away. The materials alone cost more than this amount.

ASTRONOMY FOR JANUARY.

When the year opens, the bright company of planets that lit up the southwestern sky through November and a part of December will have dispersed. Venus alone will remain conspicuous, Jupiter and Saturn being too low in the west and too near the sun. Saturn comes up with the sun on the 9th, and Jupiter on the 15th of the month.

Venus draws slowly eastward until the 22d, when she becomes stationary; she attains her greatest brilliancy on the 9th. After the 22d, she turns westward and approaches the sun with apparently increasing rapidity. Mercury passes the sun on the farther side at the beginning of the month, and moves eastward, but in low south latitude; it does not reach its greatest eastern elongation until the 1st of February, and then will be so far south that it will be difficult, if not impossible, to pick up.

The moon reaches her last quarter on the first day of the month, is in conjunction with Uranus on the 6th, and new on the 9th; she passes Mercury and Mars on the 9th, and Venus on the 12th. She comes to the first quarter on the 17th, fulls on the 23d, and leaves the month as she entered it, at her last quarter.

On the 19th, at about eleven o'clock in the evening, there will be an occultation of the star Epsilon Tauri by the moon; at Washington the star will be hidden for about an hour and ten minutes, here for a rather less time. Such a phenomenon is very interesting to watch; the gradual approach of the moon to the star, and its sudden disappearance behind the invisible dark limb of the moon may be easily watched with a field-glass or small telescope, as the star is between the third and fourth magnitudes.

By Jan. 1 the summer constellations will have mostly disappeared; at eight o'clock in the evening Lyra will be on the northwestern horizon, and Cygnus following just above it.

But the eastern sky will be bright with the winter stars; the Great Dipper will have swung around into the northeast, and with Auriga and Perseus above it, Gemini, Taurus, Cetus, Orion and the two Dogs to the southward, and Cassiopea overhead, will make the eastern half of the sky luminous. The greater and lesser Dogs add each its first magnitude star, so that there will be

eight of these in sight, though Vega is on the verge of setting.

I am often asked how to identify these constellations. Each of them has its own configuration of stars, as characteristic as the features of a man's face, and once these are familiarized they are never forgotten. Among the most characteristic of these are the Great Dipper of Ursa Major, the W group of Cassiopea, the belt and sword of Orion, the Hyades and the Pleiades in Taurus.

The easiest way to locate these roughly is perhaps by the use of a planisphere, such as can be bought from a dollar, and perhaps less, to three dollars, and which can be set at any given minute of the year. For more details, an atlas is useful, such as Klein's, Schurig's, or Upton's, which may be purchased for moderate prices at any shop where maps are sold.

With any of these, or a good celestial globe, by carefully studying the configurations and alignments of the brighter stars, the reader can in a short time become as much at home among the constellations as are most astronomers. It is a simple matter of the memory of the eye, and once learned is never forgotten.

VEGA.

THE NEW STAR IN PERSEUS.

DURING the last eight months the astronomer, whether professional or amateur, has very often found himself confronted by such questions as these: What is it? Where is it? Is it really new? Has it never been seen before? How do they know it is new? How long will it last? Can I see it? How can I find it? How can I tell it? All very natural questions and some of them easy to answer, while others are at present beyond the range of human knowledge.

It seems very strange to the casual observer, who sees the sky studded with apparently countless stars, that the presence of an additional one should attract such instant notice. He perhaps does not realize that although the stars appear to him countless, and scattered over the sky without any semblance of order, there are really only about two thousand visible at once to the ordinary eye, that not more than three hundred of these are at all conspicuous, and that the astronomer, from long acquaintance, is as familiar with their aspects as with the streets of his native town, so that the appearance of any object of considerable brightness lends an unfamiliar look to that part of the heavens, and at once attracts his notice.

Any one with a little practice may gain a sufficient familiarity with the principal groupings to readily identify a new comet or an inconspicuous planet by its appearance where he knows no star is ordinarily seen.

For instance, almost every one is so well acquainted with the group of bright stars called the Dipper that the appearance among the four stars which make up its "bowl" of a star at all approaching any one of the group in brightness, would be at once noticed as something unusual.

The New Star is a star which suddenly appeared in the middle of a large triangle formed by some of the brighter stars of the constellation Perseus. One of the points of this triangle is formed by the star Algol, one of the longest known and most remarkable of the variable stars. Its exact position is shown by a small circle on the accompanying chart (Fig. 1), which is a copy of one issued by Father Hagen of the Georgetown Observatory, for the convenience of those desiring to observe the star. By holding the chart horizontally, with its top to the left, one will have a good representation of the appearance of the constellation at dark at this season of the year, but he will need a good field-glass to see the New Star.

It was discovered on the evening of Feb. 21, 1901, by the Rev. T. D. Anderson of Edinburg, one of the best known among amateur astronomers, who had already, in 1892, distinguished himself by the discovery of a new star in Auriga, and who has a greater number of discoveries of variable stars to his credit during the last ten years than any other single observer. When first seen, the star's brightness was estimated as 2.7 magnitude; it was evidently brightening rapidly, for on the 22d it had reached the 0.9 magnitude; that is to say, it was twice as bright as on the evening before. The cable message announcing its discovery reached the Harvard College Observatory early in the evening of the 22d, and the observers at once set to work upon the star. Owing to unfavorable weather, observations were made under difficulties, but good estimates, both visual and photometric, were obtained by members of the staff. In the meantime an examination was made of all the photographs of the region taken earlier in the month, resulting in the certainty that as late as the 19th no star so bright as the eleventh magnitude was there. This means that the star had made its upward rush from invisibility in a moderate telescope to a place among the brightest in the heavens in less than three days.

On the 23d the Harvard observations showed the star to have increased to the 0.37 magnitude.

On the evening of the 23d the news had been spread, and other observatories and observers everywhere, both in this country and in Europe, had taken up the work upon the star.

My own observations began on the evening of the 24th, when I found the star brighter than any other star in the sky, Sirius only excepted. I estimated its magnitude at -0.08, twenty-five times brighter than at Anderson's first observation. On the 25th it had begun to fade fast.

A host of observers were by this time watching the

Nova Persei

(1900.0) $3^h\ 24^m.4$. + $43°\ 34'$.

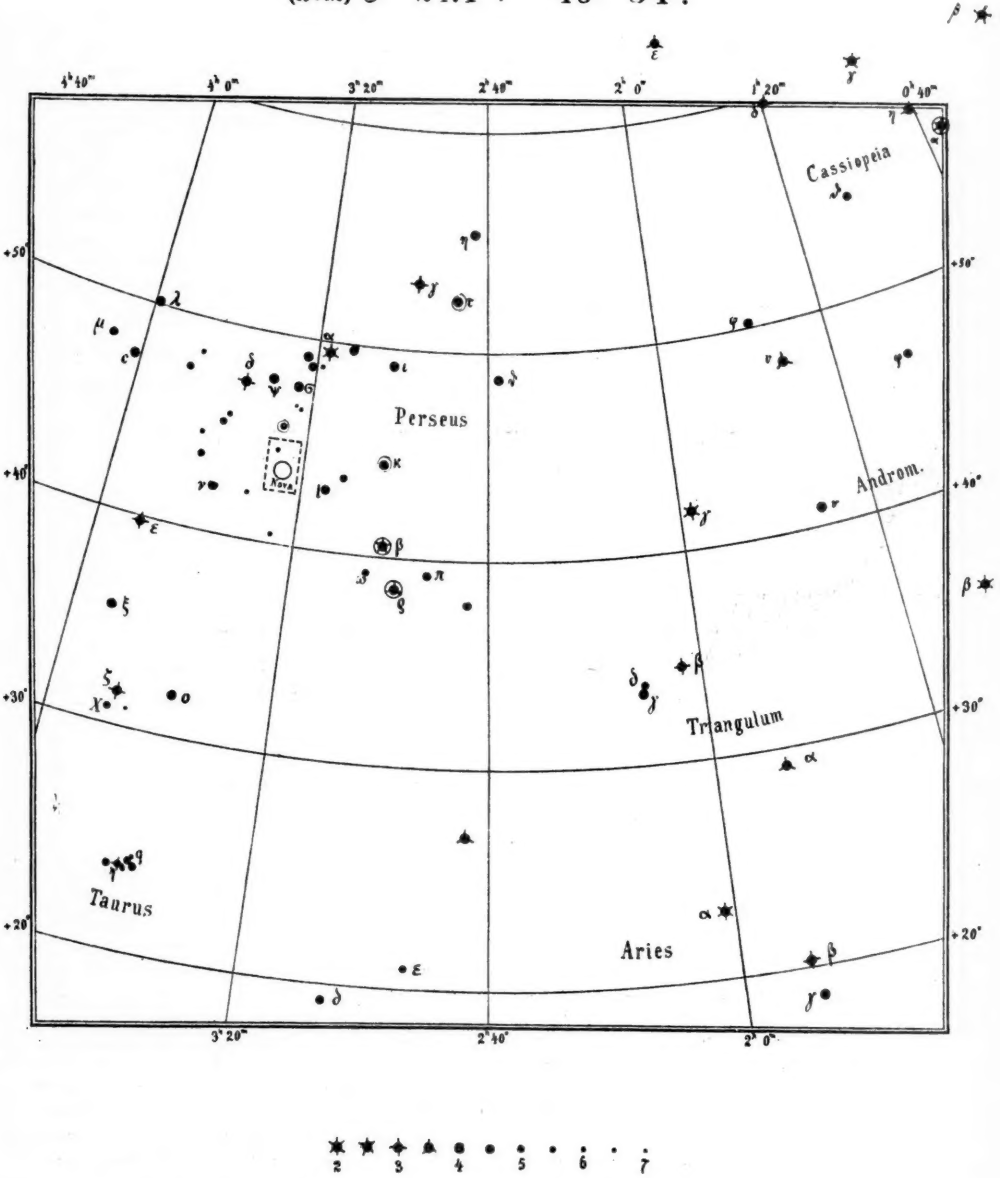


Fig. 1.

star. It continued to decrease rapidly, until in the middle of March it had reached the fourth magnitude, or a hundred times fainter than when at its brightest. After passing the fourth magnitude, its decrease became slower, and when it had passed too low in the northwest and was lost in the twilight, about the end

of April, it was still of the sixth magnitude, being decidedly slower to wane than most stars of its class.

Observations were resumed early in October, when it was found at about the seventh magnitude; at my last observation, Dec. 12, it was 7.2 magnitude.

The accompanying diagram (Fig. 2) shows graphically the course of the star's light-changes: the dates run horizontally, from left to right, and the course of its variation in brightness is shown by the heavy line, the high magnitudes being at the top and the faint ones below, as shown in the margin. The star's fluctuations are shown in this way very clearly. This is the common astronomical way of showing such changes. It is called the star's "light-curve."

The most remarkable feature of the star's variation is the series of minor fluctuations, beginning with the commencement of the decrease of light, and continuing to a date later than the beginning of May.

mental in its character, and a series of experiments was at once instituted by each of these gentlemen, with the result of independently proving that the appearance was purely photographic, and due to an excess in the star's light of the rays, for which the lense was not corrected.

The star is surrounded by, or projected on, a considerable area of scattered and wispy nebulosity. Changes in this have been announced, but are taken at the observatories with a good deal of reserve, as possibly instrumental in their origin.

The star is now visible only with the aid of a field-glass or small telescope. The small chart (Fig. 3) copied from the *Bonn Durchmusterung* shows its relation to the neighboring telescopic stars, and corresponds to the dotted square on the first chart, being three degrees square. The Nova is represented by the small circle.

These stars have been appearing from time to time,

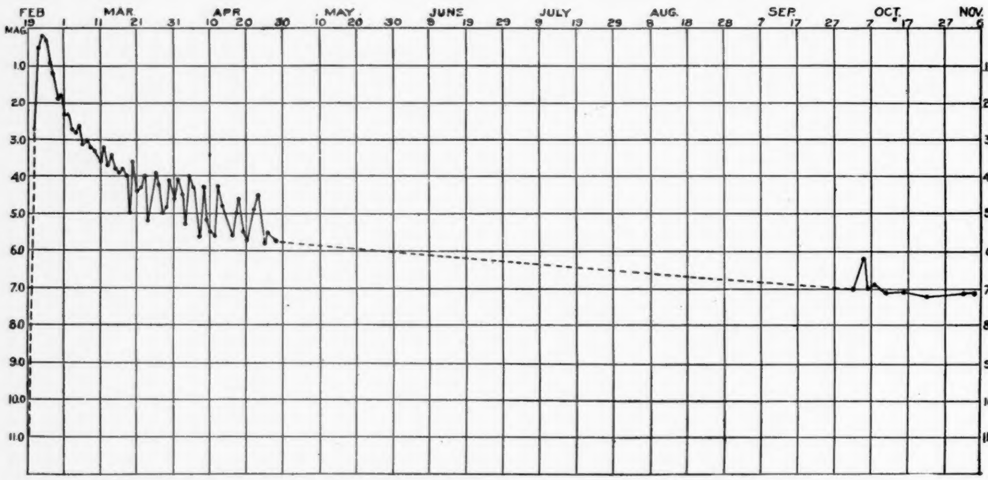


FIG. 2.

The period of these fluctuations was at first less than a day, and the light-range in the neighborhood of half a magnitude, and they increased in both particulars, until at the beginning of May the period was about five days and the light-range about two magnitudes, which is more than double the light-range of any of the ordinary short-period variable stars of similar period.

In the month of August, MM. Flammarion and Antoniadi, at the Observatory of Juvisy, in France, found, on some negatives taken on the 19th of the month, what appeared to be an aureole, or halo, of considerable dimensions surrounding the star and concentric with it; this appeared on at least two negatives, of which copies were immediately sent to a number of the observatories of Europe, with an announcement of the discovery; Wolf, at Königstuhl, and Kostinsky, of Pulkova, at once suspected the appearance to be instru-

during the memory of man. By such an occurrence Hipparchus was led to form the first catalogue of the stars of which we have knowledge. In 1572 the attention of Tycho Brahe, who afterward became a great astronomer, was first called to the study of the heavens by the appearance of such a star in the constellation Cassiopea. Lesser outbursts, says Professor Wilson, may have been frequent, and the fact, to which Professor Pickering calls attention in Circular No. 56 of Harvard College Observatory, that eight new stars have been discovered in the last fourteen years, since photographic processes have been so generally applied to astronomical research, points to this conclusion.

"What is it?" "What is the cause of it?" We simply do not know. Men have theorized; but in the absence of any tangible and certainly ascertained fact about these bodies, all theories have more or less the character of better or worse guesses. What little infor-

mation we have as to the constitution and actions of these stars comes from the spectroscope only, and are rendered more or less enigmatical by our total ignorance of the conditions of pressure, etc., there existing.

The following, quoted from the article on the New Star by Professor Wilson, in the April number of *Popular Astronomy* for the current year, are the four best known and most plausible theories which have been advanced respecting this class of stars up to the present time. The theories are very clearly stated in the article, but the language in which they are expressed is too technical to be in place in a paper of this character, so they are only given in abstract.

They are: The meeting of two swarms of meteorites moving in opposite directions; the tidal disturbances

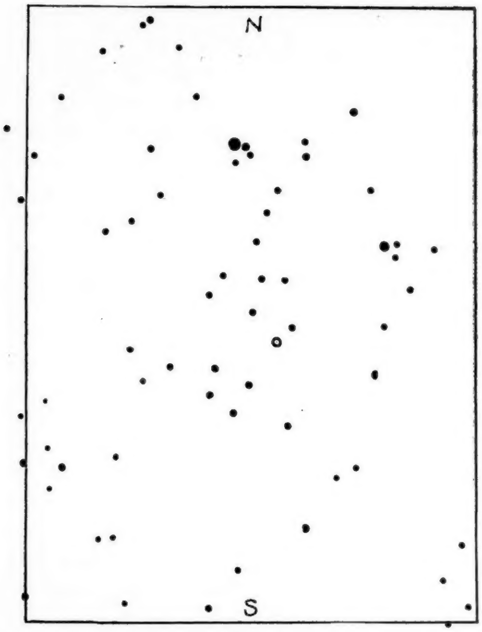


FIG. 3.

in the atmospheres of the component stars of a binary system having an orbit of great eccentricity; an outbreak caused by the shrinkage of a cooling body; the passage of a dark body through a cloud of meteorites. Of these, the second seems to me the most likely, as being the simplest and least out of the ordinary course, in that we have not to suppose a special set of conditions for the case, but are dealing with what must actually and frequently occur in the universe.

The star is now waning very slowly, if at all, and its future behavior is very hard to forecast. In the meantime it is being watched at every observatory in the world, public and private alike, and scarcely a day passes without an observation of it being secured.

VEGA.

CORRESPONDENCE.

OUR readers are invited to contribute to this department, but no responsibility is assumed for the opinions expressed in these communications.

Letters for this department should be addressed to Editor of AMATEUR WORK, 85 Water Street, Boston.

They should be plainly written on only one side of the paper, with a top margin of one inch and side margins of one-half inch.

The name and address of the writer must be given, but will not be used, if so requested.

Enclose stamps, if direct answer is desired.

In referring to other letters, give the number of the letter referred to, and the date published.

Illustrate the subject when possible by a drawing or photograph with dimensions.

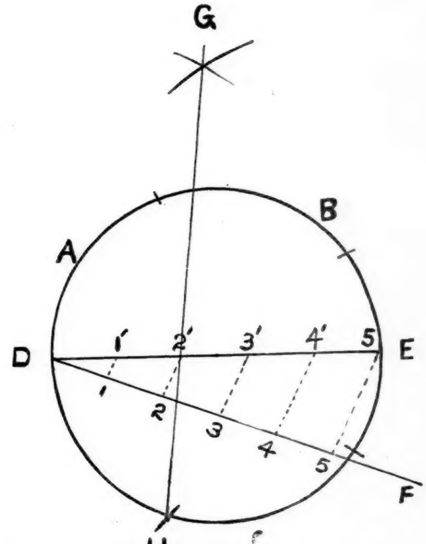
Readers who desire to purchase articles not advertised in our columns will be furnished the addresses of dealers or manufacturers, if stamp is enclosed with request.

To Divide a Circle into Any Number of Equal Parts.

ROXBURY, MASS., Dec. 10, 1901.

TO THE EDITOR:

I am greatly interested in the lessons on "Mechanical Drawing" and accept your invitation to write of any matters of interest, and so present another method of inscribing a polygon of any number of sides, or,



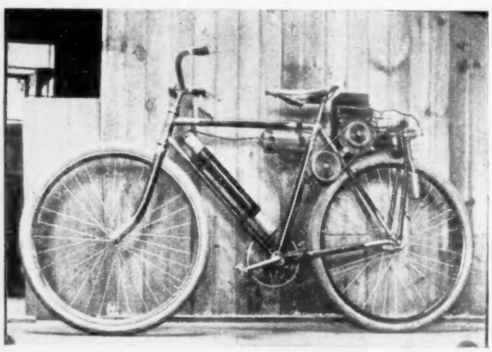
as it is sometimes stated, "to divide a circle into any number of parts." I prefer this method, as I think it quicker and easier. The enclosed sketch will illustrate how it is done. The circle A B C is to be divided into five equal parts. The diameter D E is divided into five equal parts, as given by Mr. Childs. Then with D and E as centers, and D E as radius, describe two arcs intersecting each other at G. From the intersection at G

draw the line G 2′, which is continued to the circumference at H. The arc D H is one-fifth of the circle. With the dividers step off the remaining parts. Care must be observed by either method to insure accurate results. Y.

An Amateur's Motor Bicycle.

New York City, Dec. 16, 1901.

I herein send you photographs and description of a motor-cycle which I built and which has been in use for over a year. I have ridden the same over two thousand miles. The photograph shows an Iver Johnson wheel equipped with a P-T motor driving the rear wheel by a friction wheel or roller; also a P-T automatic gasifier, muffler, plug, etc. I use a spark coil and a set of four dry batteries. The tank over the motor holds about two quarts of gasolene, which is sufficient for a run of sixty miles under favorable conditions. The castings were obtained from the P-T Motor Company of New York City. While my method of driving may be called crude, and is open to criticism, I used the same to secure a simple flexible drive without any alteration to the wheel. The friction wheel is pivoted on the clamp that holds the motor on the rear stays, and it is held against the rear tire by a helical spring, the other end of which is fastened to a clamp around the bottom bracket. A lever serves to bring it against, or to draw it away from, the tire at the



will of the operator. The friction wheel has a little lateral play to permit a good bearing, even if the tire of the wheel is not true. A flanged pulley driven by a 1″ belt connects it to the motor pulley. The motor is controlled by a single lever, which holds the exhaust valve open and shifts the spark. The motor can be started in two ways: either by pedaling, and then dropping the friction wheel, or with a crank on the motor pulley, as all gasolene automobiles are started. In crowded city streets I can pedal slowly, the motor running idly, and then drop the friction wheel when I see my way clear. I can climb a six-per-cent grade without any slip of the friction wheel, and the speed is from twelve to fifteen miles per hour on a level road. The above outfit has given me excellent satisfaction, and I use the same every day when the weather will permit.

Hoping that the brief description will be of service to your many readers, I will close.

Yours respectfully,

A. Patdevin.

CORRESPONDENCE SCHOOLS.

Of increasing importance in our educational system are what are termed "correspondence schools." In certain lines, their great value is unquestioned. To the young man deprived of a high or technical school education they provide an opportunity for acquiring theoretical instruction that could not otherwise be obtained. But, like anything else, there are limitations to the benefits that can be derived from this method of education. The theoretical character of the instruction should be remembered by those contemplating a course of study, and, where actual experience and experiment are necessary to a proper knowledge of a subject, a way should be provided to secure it as supplemental to the instruction. The value that such instruction would then have is limited only by the ability of the student.

Care should also be exercised in the selection of the course of study, and advanced or highly technical instruction should not be applied for when the more appropriate and beneficial course would be elementary arithmetic and English. The foundation should be adequate to support the superstructure. A course in civil engineering will be of small value to the man who knows but little of mathematics. To the apprentice in shop or factory who can practically apply the instruction given, such study is valuable and should be warmly encouraged by employers. To the clerk in the office a mechanical course might be useful in giving an insight into the work, but would never make him a mechanic. He would profit more from a course in mathematics or language. All the circumstances should be carefully considered and the course of instruction selected should be appropriate to the present condition and future needs of the student.

The first electric motor was the pendulum of the electric chimes made by Otto von Guericke in 1632.